

CLAIMS

We claim:

1. A system for using attitude sensors with a camera, said camera being part of a camera assembly, said camera assembly including a <sup>TRIP</sup>fixed portion and a <sup>evening place</sup>movable portion, said system comprising:

2. a first sensor coupled to said camera assembly, said first sensor measures movement of said movable portion relative to said fixed portion; and

3. a first inclinometer coupled to said camera assembly, said first inclinometer measures attitude information of at least a portion of said camera assembly.

2. A system according to claim 1, wherein:

said first sensor measures rotation of said movable portion about a first axis.

3. A system according to claim 2, wherein:

said first inclinometer measures a component of the movement of said first axis.

4. A system according to claim 1, wherein:

said first sensor is an optical encoder.

5. A system according to claim 1, further comprising:

a second inclinometer coupled to said camera assembly, said first inclinometer and said second inclinometer are used to measure an orientation of said camera assembly.

1 X 6. A system according to claim 5, wherein:  
2 said first encoder<sup>18</sup> is coupled to said movable portion;  
3 said first inclinometer<sup>28</sup> is coupled to said fixed portion<sup>30</sup>; and  
4 said second inclinometer is coupled to said fixed portion.

7. A system according to claim 5, wherein:  
2 said first sensor measures panning of said camera;  
3 said first inclinometer<sup>28</sup> measures roll of said fixed portion<sup>30</sup>; and  
4 said second inclinometer measures pitch of said fixed portion.

8. A system according to claim 5, wherein:  
2 said first sensor<sup>20</sup> measures tilting of said camera;  
3 said first inclinometer<sup>28</sup> measures roll of said fixed portion<sup>30</sup>; and  
4 said second inclinometer measures pitch of said fixed portion.

9. A system according to claim 5, wherein:  
2 data from said first sensor is combined with data from said first inclinometer  
3 and said second inclinometer in order to describe said camera's orientation.

10. A system according to claim 5, wherein:  
2 data from said first sensor is combined with data from said first inclinometer  
3 and said second inclinometer, said combined data is used to transform a location in  
4 a first coordinate system to a position in a second coordinate system.

11. A system according to claim 5, further comprising:  
2 a second sensor coupled to said camera assembly, said first sensor measures

3 movement of said movable portion about a first axis and said second sensor  
4 measures movement of said movable portion about a second axis, said first  
5 inclinometer<sup>28</sup> and said second<sup>30</sup> inclinometer measure movement of said first axis<sup>20</sup> and  
6 said second axis.

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1 12. A system according to claim 1, further comprising:  
2 one or more processors, said one or more processors receive data from said  
3 first inclinometer and said first sensor, said one or more processors programmed  
4 to determine attitude parameters describing an orientation of said camera based on  
5 said data from said first inclinometer and said first encoder.

1 13. A system according to claim 12, wherein:  
2 said one or more processors use said attitude parameters to transform a  
3 location in a first coordinate system to a position in a second coordinate system.

1 14. A system according to claim 1, wherein:  
2 said fixed portion includes a tripod and a tripod head interface;  
3 said movable portion includes at least a portion of a tripod head and said  
4 camera;  
5 said first sensor is coupled to said tripod head;  
6 said first inclinometer is coupled to said tripod head interface.

1 15. A system according to claim 1, further comprising:  
2 sensor electronics located with said camera assembly and in communication  
3 with said first sensor and said first inclinometer, said sensor electronics reads data  
4 from said first sensor and said first inclinometer and packages said data for

5 transmission to a processor.

1 16. A system according to claim 15, wherein:  
2 said sensor electronics encodes said packaged data for transmission in an  
3 audio signal to a first location, said processor being located at said first location.

1 17. A system according to claim 1, further comprising:  
2 a second <sup>20</sup> inclinometer coupled to said camera assembly, said first <sup>28</sup>  
3 inclinometer is mounted in a first plane, said second inclinometer is mounted in a  
4 second plane, said first plane being orthogonal to said second plane;  
5 a second <sup>20</sup> sensor coupled to said movable portion, said first <sup>18</sup> sensor and said  
6 second sensor are optical encoders, said first sensor measures rotation of said  
7 movable portion about a first axis, said second sensor measures rotation of said  
8 movable portion about a second axis, said first and second inclinometers measure  
9 movement of said first axis and said second axis;  
10 ✓ a processor programmed to combine data from said first inclinometer, said  
11 second inclinometer, said first sensor and said second sensor in order to describe an  
12 orientation of said camera, said processor is in communication with said first  
13 inclinometer, said second inclinometer, said first sensor and said second sensor.

1 18. A system according to claim 17, further comprising:  
2 a first <sup>24</sup> gyro in communication with said processor; and  
3 a second <sup>26</sup> gyro in communication with said processor, said processor  
4 combines data from said first gyro and said second gyro with data from said first  
5 <sup>28</sup> inclinometer, said second <sup>30</sup> inclinometer, said first <sup>18</sup> sensor and said second <sup>20</sup> sensor

1 19. A method for using attitude sensors with a camera, said camera  
2 being part of a camera assembly, said camera assembly including a fixed portion and  
3 a movable portion, said system comprising:

4 sensing data from a first sensor, said first sensor measures movement of said  
5 movable portion relative to said fixed portion;

6 sensing data from a first inclinometer, said first inclinometer measures  
7 absolute attitude information of at least a portion of said camera assembly; and

8 combining said data from said first sensor with said data from said first  
9 inclinometer.

1 20. A method according to claim 19, wherein said step of combining  
2 includes:

3 creating one or more transformation matrices using said data from said first  
4 sensor and said data from said first inclinometer.

1 21. A method according to claim 19, further comprising the step of:

2 selecting a location in a scene;

3 converting said location to a position in a video image from said camera,  
4 said step of converting is based on said step of combining; and

5 adding a graphic to said video image from said camera at said position.

1 22. A method according to claim 19, wherein:

2 said first sensor measures rotation of said movable portion about a first axis;

3 and

4 said first inclinometer measures a component of the orientation of said first  
5 axis.

1 23. A method according to claim 19, further comprising the step of:  
2 adding said data from said first sensor and said first inclinometer to an audio  
3 signal for transmission to a first location, a first processor is located at said first  
4 location, said first processor performs said step of combining.

1 24. A method according to claim 19, further comprising the step of:  
2 sensing data from a first gyro, said step of combining includes combining  
3 said data from said first gyro with said data from said first sensor and said data from  
4 said first inclinometer

1 25. A system for using attitude sensors with a camera, said camera being  
2 part of a camera assembly, said camera assembly including a fixed portion and a  
3 movable portion, said system comprising:  
4 a first sensor coupled to said camera assembly, said first sensor measures  
5 movement of said movable portion with respect to said fixed portion; and  
6 a first gyro coupled to said camera assembly, said first gyro measures  
7 attitude information of at least a first portion of said camera assembly.

1 26. A system according to claim 25, wherein:  
2 said gyro is a fiber optic gyro.

1 27. A system according to claim 25, wherein:  
2 said first sensor measures rotation of said movable portion about a first axis.

1 28. A system according to claim 27, wherein:

2 said first gyro measures movement of said first axis.

1 29. A system according to claim 25, further comprising:  
2 a second gyro coupled to said camera assembly, said second gyro capable  
3 of measuring attitude information of at least said portion of said camera assembly,  
4 data from said first gyro, said second gyro and said first sensor is combined to  
5 describe an orientation of said camera.

1 30. A system according to claim 25, further comprising:  
2 a processor, said processor receives and combines data from said first sensor  
3 and said first gyro to describe an orientation of said camera.

1 31. A system according to claim 25, further comprising:  
2 a first inclinometer coupled to said camera assembly; and  
3 a processor, said processor receives and combines data from said first  
4 sensor, said first gyro and said first inclinometer to describe an orientation of said  
5 camera.

1 32. A system according to claim 25, further comprising:  
2 a first inclinometer coupled to said camera assembly, said first inclinometer  
3 capable of measuring attitude information in a first plane for said camera assembly;  
4 a second inclinometer coupled to said camera assembly, said second  
5 inclinometer capable of measuring attitude information in a second plane for said  
6 camera assembly, said first plane is different from said second plane;  
7 a second gyro coupled to said camera assembly, said second gyro capable  
8 of measuring attitude information in a third plane for at least said portion of said

9 camera assembly, said first gyro measures attitude information in a fourth plane for  
10 at least said portion of said camera assembly, said third plane is different from said  
11 fourth plane; and

12 a second sensor coupled to said camera assembly, said first sensor measures  
13 movement of said movable portion with respect to said fixed portion along a first  
14 axis, said second sensor measures movement of said movable portion with respect  
15 to said fixed portion along a second axis different, said first axis is different from  
16 said second axis

1 33. A system according to claim 32, further comprising:

2 one or more processors receiving and combining data from said first gyro,  
3 said second gyro, said first inclinometer, said second inclinometer, said first sensor  
4 and said second sensor;

5 said one or more processors use said combined data to add a graphic to a  
6 video image from said camera at a first position in said video image, said graphic  
7 corresponds to a three dimensional location within a field of view of said camera,  
8 said three dimensional location corresponds to said first position in said video  
9 image.

1 34. A system according to claim 33, further comprising:

2 an audio signal generator in communication with and receiving sensor data  
3 from said first gyro, said second gyro, said first inclinometer, said second  
4 inclinometer, said first sensor and said second sensor, said audio signal generator  
5 creates a compatible audio signal which includes said sensor data, said audio signal  
6 generator communicates said compatible audio signal to said camera for  
7 transmission in said camera audio signal; and



8 a data extractor receiving said camera audio signal and extracting said  
9 sensor data, said data extractor in communication with said one or more processors.

1 35. A system according to claim 25, further including:  
2 a first circuit for compensating for offset of said first gyro.

1 36. A system according to claim 25, further including:  
2 a first circuit for reducing error due to drift in said first gyro.

1 37. A method for using attitude sensors with a camera, said camera  
2 being part of a camera assembly, said camera assembly including a fixed portion and  
3 a movable portion, said system comprising:

4 sensing data from a first sensor, said first sensor measures movement of said  
5 movable portion relative to said fixed portion;

6 sensing data from a first gyro, said first gyro measures attitude information  
7 of at least a portion of said camera assembly; and

8 combining said data from said first sensor with said data from said first gyro.

1 38. A method according to claim 37, further including the step of:  
2 reducing errors due to drift in said first gyro.

1 39. A method according to claim 37, further comprising the step of:  
2 selecting a location in a scene;  
3 converting said location to a position in a video image from said camera,  
4 said step of converting is based on said step of combining; and  
5 adding a graphic to said video image from said camera at said position.

1 40. A method according to claim 37, further comprising the step of:  
2 sensing data from a second gyro, said step of combining includes combining  
3 said data from said second gyro with said data from said first sensor and said data  
4 from said first gyro.

1 41. A method according to claim 37, further comprising the step of:  
2 adding said data from said first sensor with said data from said first  
3 inclinometer to an audio signal for transmission to a first location, a first processor  
4 is located at said first location, said first processor performs said step of combining.

1 42. A method according to claim 37, further including the step of:  
2 compensating for offset of said first gyro.

1 43. A method for using camera attitude sensors with a camera, the  
2 method comprising the steps of:  
3 sensing camera attitude information for said camera using a first set of one  
4 or more camera attitude sensors; and  
5 transmitting said camera attitude information as an audio signal to one or  
6 more processors.

1 44. A method according to claim 43, wherein:  
2 said camera has a video signal output, an audio signal output and an audio  
3 signal input; and  
4 said step of transmitting includes communicating said camera attitude  
5 information to said audio signal input.

1 45. A method according to claim 43, further comprising the step of:  
2 encoding said camera attitude information onto audio or video signal prior  
3 to transmitting.

1 46. A method according to claim 43, further comprising the step of:  
2 removing said camera attitude information from said audio signal.

1 47. A method according to 46, further comprising the step of:  
2 using said camera attitude information to add a graphic to a video from said  
3 camera, said step of using being performed subsequent to said step of determining.

1 48. A system for using attitude sensors with a camera, said camera  
2 having a camera video signal and a camera audio signal in communication with  
3 remotely located production equipment, the system comprising:  
4 a first camera attitude sensor; and  
5 an audio signal generator in communication with said first camera attitude  
6 sensor, said audio signal generator creates an audio signal which includes data from  
7 said first camera attitude sensor, said audio signal generator communicates said  
8 audio signal for transmission to said remotely located production equipment.

1 49. A system according to claim 48, wherein:  
2 said audio signal generator includes a modulation circuit.

1 50. A system according to claim 48, further comprising:  
2 a data extractor receiving said audio signal and extracting said data from

Year	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100
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$$\begin{matrix} 1 \\ 2 \end{matrix}$$

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- 3
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